

CLAIMS

1. A microwave dental system comprising:
 - a hand-held dental tool including:
 - an antenna positioned at a distal end of the tool and configured to be selectively positioned within a mouth of a patient adjacent at least one exterior surface of a tooth; and
 - a waveguide connected to the antenna;
 - a source of microwave energy operably coupled to the waveguide, including a control system for controlling delivery of microwave energy to the waveguide.
 - such that the dental tool delivers microwave energy to the at least one exterior surface of the tooth.
2. The microwave dental system of claim 1 wherein control system controls the source of microwave energy to deliver less than 10 W to the antenna.
3. The system of claim 1 wherein the control system operates the source of microwave energy at voltages in a range of between 10 and 65 V.
4. The system of claim 1 wherein the control system operates the source of microwave energy at frequencies of between 1 GHz to 50 GHz.
5. The system of claim 4 wherein the control system operates the source of microwave energy at frequencies between 14 GHz to 24 GHz.
6. The system of claim 1 wherein the control system includes a feedback sensor and the microwave energy is applied to allow the feedback sensor to detect caries.
7. The system of claim 1 wherein the microwave energy is applied by the control system at a frequency and power to preferentially heat caries.
8. The system of claim 1 wherein the microwave energy is applied to polymerize a resin matrix to create a dental composite.

9. The system of claim 8 wherein the resin matrix is comprised of polyfunctional methacrylate esters and oligomers including Bis-GMA and microwave sensitive initiators.

10. The system of claim 8 wherein the hand-held tool further includes a mechanism to deliver the resin matrix to the tooth.

11. The system of claim 1 wherein the microwave energy is applied as part of a non-invasive procedure.

12. The system of claim 1 further comprising means for providing cooling to the hand-held tool during the application of microwave energy.

13. The system of claim 1 wherein the antenna further includes an antenna choke made of microwave absorbing materials.

14. A microwave dental system comprising:

a hand-held dental tool including:

an antenna positioned at a distal end of the tool and configured to be selectively positioned within a mouth of a patient adjacent at least one tooth; and

a waveguide connected to the antenna;

a source of microwave energy operably coupled to the waveguide, including a control system for controlling delivery of microwave energy to the waveguide such that less than 10 W of microwave energy is delivered to the antenna at frequencies between 1 GHz to 50 GHz.

15. A microwave dental system comprising:

a hand-held dental tool including:

an antenna positioned at a distal end of the tool and configured to be selectively positioned within a mouth of a patient adjacent at least one tooth; and

a waveguide connected to the antenna;

a source of microwave energy operably coupled to the waveguide, including a control system for controlling delivery of microwave energy to the waveguide, the control system including a feedback sensor such that the microwave energy is applied to the tooth to allow the feedback sensor to detect the existence of caries in the tooth.

16. A microwave dental system comprising:
a hand-held dental tool including:
an antenna positioned at a distal end of the tool and configured to be selectively positioned within a mouth of a patient adjacent at least one tooth, the antenna including an antenna choke to restrict transmission of microwave energy to surrounding tissue; and
a waveguide connected to the antenna;
a source of microwave energy operably coupled to the waveguide, including a control system for controlling delivery of microwave energy to the waveguide.
17. A method for intra-orally treating caries comprising:
identifying a carious lesion in a tooth in a patient's mouth; and
using a hand-held dental tool to intra-orally apply microwave energy to at least one exterior surface of the tooth to non-invasively treat the carious lesion.
18. The method of claim 17 wherein the hand-held tool includes a sensor for measuring microwave energy absorbed by a tooth and wherein the carious lesion is identified by determining an amount of microwave energy absorbed by the tooth indicative of a carious lesion.
19. The method of claim 17 further comprising:
applying a sealant to the tooth after the application of microwave energy.
20. The method of claim 17 wherein a portion of the carious lesion is mechanically removed prior or after to the application of microwave energy.
21. The method of claim 17 further comprising:
applying a resin matrix to the tooth; and
using the hand-held dental tool to polymerize the resin matrix.
22. The method of claim 17 wherein hand-held tool includes an antenna that is operatively coupled to a source of microwave energy by a waveguide and wherein the source of microwave energy is operated to deliver less than 10 W of microwave energy to the antenna.
23. The method of claim 22 wherein the source of microwave energy is operated at voltages in a range of between 10 and 65 V.

24. The method of claim 22 wherein the the source of microwave energy is operated at frequencies of between 1 GHz to 50 GHz.

5 25. The method of claim 24 wherein the source of microwave energy is operated at frequencies between 14 GHz to 24 GHz.

26. A dental composite intra-orally polymerized by application of microwave energy from a hand-held dental tool, the composite being comprised of polyfunctional methacrylate esters and
10 oligomers including Bis-GMA and microwave sensitive initiators.

27. The dental composite of claim 26 further comprising disinfectant materials.

28. The dental composite of claim 26 further comprising microwave absorbing materials.

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